



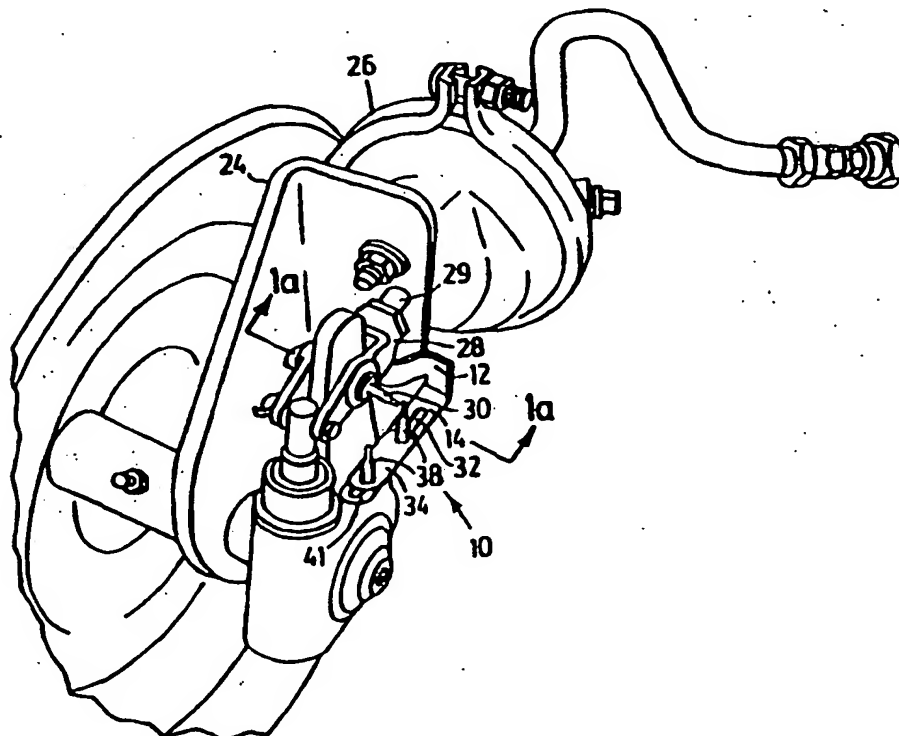
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| (51) International Patent Classification ⁶ : F16D 66/02, B60T 17/22 | | A1 | (11) International Publication Number: WO 98/37338 |
| | | | (43) International Publication Date: 27 August 1998 (27.08.98) |
| (21) International Application Number: PCT/CA98/00124 | | (81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). | |
| (22) International Filing Date: 19 February 1998 (19.02.98) | | <p>Published With international search report.</p> | |
| (30) Priority Data: | | | |
| 2,198,072 20 February 1997 (20.02.97) CA | | | |
| 2,228,086 28 January 1998 (28.01.98) CA | | | |
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(54) Title: PLANAR VISUAL BRAKE STROKE INDICATOR

(57) Abstract

A visual brake stroke indicator (10) comprising a bracket (12) that has an elongated member (14) with an attachment portion at one end, and a continuous slot (32) extending along the length of the extended member (14). The attachment portion (16) may be in the same plane as the elongated member (14). The elongated member (14) may be tapered in shape to help reduce vibrational forces along the elongated member (14). The bracket (12) may be mounted to a chamber mounting bracket (24) which supports a brake chamber (26) and a clevis assembly (28) including a clevis pin (30). The attachment portion (16) is generally located at a right angle radius to the rest of the elongated member (14) thereby reducing stress on the elongated member. A spacer plate (34) may be mounted on the elongated arm via an attachment means (36) that also holds in place the indicating means (38). The indicating means (38) may be mounted at a predetermined distance relative to said clevis pin (30), the position of the indicating means (38) to said clevis pin (30) being indicative of the brake stroke condition on the vehicle braking system.



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DescriptionPlanar Visual Brake Stroke Indicator5 Field of Invention.

This invention relates generally to a braking system, and in particular to a visual brake stroke indicator that may be easily installed on an air-brake chamber and can determine brake stroke condition without requiring the user to crawl under the vehicle.

10 Background Art

It is generally recognized that there is a need to be able to accurately determine the brake stroke condition on a vehicle's brakes, so as to ensure the timely maintenance of the vehicles' braking system. As most braking systems are difficult to inspect for the brake stroke condition, many operators of vehicles, such as trailers and trucks, let the maintenance
15 of the brakes lapse which can result in a loss of brake effectiveness.

Prior art adjustment indicators have been devised to address the aforementioned problems. For example, United States Patent No. 4,279,214 issued July 21, 1981, discloses a brake adjustment indicator which can be installed on a vehicle with pneumatic brakes. The
20 indicator includes a sleeve that loosely fits over the push rod of a pneumatic actuator.

United States Patent No. 4,776,438 issued October 11, 1988, discloses a brake adjustment indicator which includes a mounting bracket having an elongated body with a slot that runs parallel to a rod that extends through an air brake chamber and connects at one end
25 to the brake arm by a clevis pin.

United States Patent No. 4,879,964 issued November 14, 1989, discloses an air brake adjustment marker that includes an air supply, an air canister, and moveable members that include a push rod that extends from the air canister and has a first extended position and a
30 second over-extended position. The adjustment marker includes a chain attached to the push rod, and an indicator flag that is activated when the push rod is in the over-extended position.

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United States Patent No. 5,244,061 issued September 14, 1993, discloses an air brake stroke length gage that operates in conjunction with an air brake system. The gage comprises of a stroke length indicator that is mounted on the push rod, and a reference marker that is attached to the air brake system at a distance which corresponds to the appropriate stroke length for the brake system when properly adjusted.

United States Patent No. 5,320,198 issued June 14, 1994, discloses a indicator for indicating the setting and linear stroke movement of a brake rod of a brake assembly. The gage includes reference indicators that are located on both the brake rod's clevis and on the arm of the brake's slack adjustment member, thereby indicating the brake rod travel and the need for brake adjustment.

United States Patent No. 5,441,128 issued August 15, 1995, discloses a bracket body that can be attached to a brake rod and to the clevis member of a conventional brake adjustment apparatus. The bracket body provides for an indirect measurement of the brake rod travel and adjustment.

Finally, Canadian patent application 2,186,271 which was laid open on November 2, 1996 shows the use of a brake adjustment indicator including a mounting bracket, having an elongated body with a slot, and a spacer for receiving two bolts for indicating limit positions.

Disclosure of Invention

An object of one aspect of the present invention is to provide an improved visual brake stroke indicator. A further object of this invention provides an improved visual brake stroke indicator requiring fewer parts.

In accordance with one aspect of the present invention, there is provided a visual brake stroke indicator which is mounted on a chamber mounting bracket, outside the brake chamber and includes a clevis assembly with a modified clevis pin.

In accordance with still another aspect of the invention, there is provided a visual brake stroke indicator which comprises of a bracket that includes an elongated member

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having at one end, an attachment portion at a right angle radius to the elongated member. The right angle radius reduces the stress on the elongated member. The elongated member may be tapered in shape, being wider at the end with the attachment portion. The elongated member also includes of a continuous slot, a spacer plate with an attachment means, and an
5 indicating means mounted at a predetermined distance from the clevis pin.

In accordance with a further aspect of the invention, there is provided a visual brake stroke indicator which may be easily installed in a short amount of time on all types of cam operated brake systems, and is relatively inexpensive but very durable.

10

Brief Description of Drawings

A detailed description of the preferred embodiment is provided herein below with reference to the following drawings, in which:

15 Fig. 1 is a perspective view of the visual brake stroke indicator, in accordance with the preferred embodiment of the present invention.

Fig. 1a is a top view of the clevis pin in accordance with the preferred embodiment of the present invention.

20

Fig. 2 is top view of the preferred embodiment in a first released position.

Fig. 3 is top view of the preferred embodiment in a second activated position.

25 Fig. 4 is top view of the preferred embodiment in a second activated position requiring that the brakes need adjustment.

Fig. 5a is a top view of the bracket of the preferred embodiment of the present invention.

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Fig. 5b is a front elevational view of the bracket of the preferred embodiment of the present invention.

Fig. 5c is a top end view of the bracket of the preferred embodiment of the present invention.

Fig. 6a is a top view of the bracket of a second preferred embodiment of the present invention.

Fig. 6b is a front elevational view of the bracket of a second preferred embodiment of the present invention.

Fig. 6c is a top end view of the bracket of a second preferred embodiment of the present invention.

Figures 7a, b, c and d shown an alternate embodiment of a pointer than can be used in place of the clevis pin indicator.

Fig. 8a is a top view of the bracket of a third preferred embodiment of the present invention.

Fig. 8b is a front elevational view of the bracket of a third preferred embodiment of the present invention.

Fig. 8c is a top end view of the bracket of a third preferred embodiment of the present invention.

In the drawings, preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood that the description and drawings are only for the purpose of illustration and as an aid to understanding, and are not intended as a definition of the limits of the invention.

Best Mode for Carrying Out the Invention

In the description which follows, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings are not

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necessarily to scale and in some instances proportions may have been exaggerated in order to more clearly depict certain features of the invention.

Referring to Figure 1, there is illustrated in a perspective view, an indicator 10 for
5 determining brake stroke condition on a vehicle braking system in accordance with the preferred embodiment of the present invention. The indicator 10 for determining brake stroke condition includes a bracket 12 having an elongated member 14 that has an attachment portion 16 at one end 18. The elongated member 14 may occupy a first plane that is substantially perpendicular to a second plane occupied by the attachment portion 16.
10 Moreover, the attachment portion 16 is located at a right angle to the elongated member 14. A radius 20 is located between attachment portion 16 and elongated member 14. The attachment portion 16 may have a plurality of holes 22 that allows the bracket 12 to be attached to a chamber mounting bracket 24 which supports a brake chamber 26. The brake chamber 26 has a clevis assembly 28 that includes a clevis pin 30 that connects the clevis
15 assembly 28 to a brake arm 29. The elongated member 14 may run parallel to the clevis assembly 28, and may have a curve 31 at the mid-point of the elongated member so as to extend towards the clevis assembly 28 and specifically the clevis pin 30.

The elongated member 14 has a continuous slot 32 extending down the length of the
20 elongated member 14. The continuous slot 32 may be of variable lengths so as to accommodate various brake systems such as on a bus. The elongated member 14 may also be tapered in shape, generally being wider at the end 18 having the attachment portion 16 which helps to reduce the vibrational forces along the elongated member 14 during the use of the indicator 10. More specifically, since the attachment portion 16 is bolted to the
25 chamber mounting bracket 24, the elongated member 14 is free to vibrate as the vehicle moves along the road. Therefore during use, stresses are localized along the bend 43 and eventually the bend 43 will break much like the repeated bending of metal. These stresses can be reduced by including the radius 20, reducing the amount or weight of metal from the radius 20 by tapering the elongated member 14, and including the curve 31 at the mid-point
30 of the elongated member 14.

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A spacer plate 34 may be detachably mounted to the continuous slot 32 along the elongated member 14 by indicating means which also function as an attachment means 36 to attach the spacer plate to the elongated member 14. The attachment means 36 comprises two bolts 43 and 45 which are thread through the continuous slot 32 of the elongated member 14 and two holes 47 and 49 of the spacer plate 34. Two nuts 51 and 53, and two locking washers 55 and 57 are provided. The bolts 43 and 45 also function as an indicating means, that is they indicate the two limit positions of acceptable brake travel. However, in the preferred embodiment an indicating means 38 may be adapted so that the indicating means 38 may be mounted on the spacer plate 34 by the attachment means 36 at a predetermined distance from the clevis pin 30. The indicating means 38 consists of yellow plastic sleeves 42 that fit over the bolts 43 and 45 and define digits 39. Moreover, since the bolts 43 and 45 fit through holes 47 and 49, the distance between the indicating means is set and may not accidentally move if just a continuous slot 32 were used with a spacer plate 34. The position of the indicating means 38 define the acceptable brake stroke travel between the digits 38, and thereby define the degree of wear of the brakes.

In operation, the indicator 10 for determining brake stroke condition can be used to quickly and efficiently determine the condition of the brake stroke on the vehicle. How this is achieved is explained here below with reference to Figures 1-4. The bracket 12 may be mounted through the attachment portion 16, on the chamber mounting bracket 24 by a bolting means 40, such as a stud 42 and nut 44. The chamber mounting bracket 24 supports the brake chamber 26 which in turn supports the clevis assembly 28. The clevis assembly 28 extends outwardly from the brake chamber 26 and the chamber mounting bracket 24, to be connected to the brake arm 29 by a clevis pin 30.

25

The elongated member 14 with the indicating means 38 secured to spacer plate 34, may run parallel to the clevis assembly 28 such that when the brakes are in the fully released position, the clevis pin 30 sits at a predetermined distance from the indicating means 38 or plurality of digits 39. When the brakes of the vehicle are applied the clevis pin moves within the range of the plurality of digits 39, thereby determining that the stroke on the brakes is still at an acceptable level. When the brakes are applied and the clevis pin 30 moves beyond the range of the plurality of digits 39, the stroke on the brakes may be determined to be

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unacceptable and require adjustment. The clevis pin can include a plastic sleeve 42 frictionally attached to a reduction in the diameter 43 of the clevis pin.

Second Preferred Embodiment

5 Referring to Figures 6a, 6b and 6c, there is illustrated an indicator 10 for determining brake stroke condition on a vehicle braking system in accordance with the second preferred embodiment of the present invention. The indicator 10 for determining brake stroke condition includes a bracket 12 having an elongated member 14 that has an attachment portion 16 at one end 18. The attachment portion 16 may generally lie along a first plane
10 which may be substantially perpendicular to the elongated member 14 which may generally lie along a second plane. A radius 20 is located between attachment portion 16 and elongated member 14. The attachment portion 16 may have a plurality of holes 22 that allows the bracket 12 to be attached to a chamber mounting bracket 24 which supports a brake chamber 26. In a preferred embodiment one hole 22 is provided and the centre line 75
15 of second plane occupied by the elongated member 14 passes through the confines of the hole 22, and more preferably through its centre.

The indicator illustrated in Figures 6a, 6b and 6c may be stamped from a flat sheet of metal having the appropriate thickness. The stamped indicator would have the elongated
20 member 14 and the attachment portion 16 in the same plane. Thereafter the stamped indicator would be bent so as to cause the elongated member to rotate or pivot relative the attachment portion by 90 degrees. In this way, the plane of the attachment portion lies generally substantially perpendicular to the elongated member 14. Furthermore, the elongated member 14 is bent so the plane of the elongated member 14 passes through the
25 centre of hole 22. In this way one universal indicator 10 can be used on the front, back, left or right sides or the vehicle rather than using four separately configured indicators, which leads to a more complicated installation. The relationship of the plane of the elongated member 14 passing through the hole 22 permits the use of one universal indicator.

30 In another embodiment the bolts 43 and 45 may be replaced by single U-shaped or second bracket 59. The second bracket 59 may be detachably mounted to the continuous slot 32 along the elongated member 14 by an attachment means 61. The second bracket 59 may

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comprise of a base 60 and two members 62 extending vertically from the base 60. The attachment means 61 may comprise of a single bolt 63 that is thread through the continuous slot 32 of the elongated member 14 and a hole 65 and of the second bracket 59. A nut 67 and a locking washer 69 may be provided. The two vertically extending members 62 of the
5 second bracket 59 may be mounted on the continuous slot 32 at a predetermined distance from the clevis pin 30. The two vertically extending members 62 may further comprise of yellow plastic sleeves 42 so as to define digits 39. The base 60 may further include an abutment means 70 that may prevent the second bracket 59 from rotating around the continuous slot 32. The abutment means 70 may consist of one or, as shown, two punched
10 portions that are received into the slot 32 and bear against or abut along the sides or confines of the slot so as to prevent relative movement of the second bracket 59 and elongated member 14 once it is fastened by the bolt 63. The use of a second bracket 59 provides a simple one piece device that may be easily installed. The position of the two vertically extending members 62 to the clevis pin 30 may be indicative of the brake stroke condition
15 on the vehicle braking system.

In summary a visual brake stroke indicator is provided with improved features for easy determination of brake stroke condition on a vehicle braking system. Furthermore, by using an attachment portion 16, which is at right angles to the elongated member 14, one
20 indicator 10 may be used on the right side, left side or front or back of the vehicle.

Various embodiments of the invention have now been described in detail. For example, the clevis pin indicated or shown in Figure 1a may be replaced by a pointer 90 as shown in Figures 7a, b, c and d. The pointer 90 comprises of two parts 92 and 94 adapted
25 to be clamped unto the push rod 29 but otherwise function similar to the clevis pin. The push rod 29 is adapted to be clamped between the two semicircular sections shown in Figure c and by bolts going through holes 95 (not shown) The usual clevis pin will be required to activate the braking mechanism through the push rod. A plastic sleeve similar to sleeve 42 may be added to extension 92.

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Since changes in and/or additions to the above-described best mode may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to said details.

5 Further Alternate Embodiment

Referring to figures 8a, 8b and 8c there is illustrated an indicator 10 for determining brake stroke condition on a vehicle braking system in accordance with a further preferred embodiment of the present invention which is similar to that shown in figure 6a, 6b and 6c.

10 The indicator 10 shown in figures 8a, 8b and 8c are well adapted for use when the digits 39 are better oriented in a plane parallel to the elongated member 14. For example, it can be used for air brake systems on rail cars. However, the invention is not limited to rail cars. The indicator 10 for determining brake stroke condition includes a bracket 12 having an elongated member 14 that has an attachment portion 16 at one end 18. The attachment

15 portion 16 may generally lie along a first plane which is substantially perpendicular to the elongated member 14 which may generally lie in second plane. Again the radius 20 is located between the attachment portion 16 and elongated member 14 as described above. The attachment portion 16 also may have a plurality of holes 22 that allows the bracket 12 to be attached to a chamber mounting bracket 24 which supports a brake chamber 26. In the

20 preferred embodiment shown in figures 8a, 8b and 8c one hole 22 is provided and the centre line 75 of the second plane occupied by the elongated member 14 passes through the confines of the hole 22 and more particularly through its centre.

The indicator illustrated in figures 8a, 8b and 8c may also be stamped from a flat

25 sheet of metal having the appropriate thickness as described in relation to the embodiment shown in figure 6a, 6b and 6c. More particularly by stamping the elongated member 14 so that it is bent so that the plane of the elongated member 14 passes through the centre of hole 22 one universal indicator may be used on the front, back, left and right sides of vehicle rather than using four separate configured indicators, which leads to a more complicated

30 installation. The relationship of the plane of the elongated member 14 passing through the hole 22 permits the use of one universal indicator.

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In the embodiment shown in figures 8a, 8b and 8c the bracket may be replaced by a single flat shaped or third bracket 159. The third bracket 159 may be detachably mounted to the continuous slot 32 along the elongated member 14 by an attachment means 161. The third bracket 159 may comprise of a base 160 and two members 162 extending outwardly from the base 160. The attachment 161 comprises two bolts 163 that extend through the continuous slot 32 of the elongated member 14 and two holes 165 of the third bracket 159. Nuts 167 and locking washers 169 may be provided. The holes 165 extending through the third bracket 159 may be elongated or oblong as shown in the figures so that not only may the third bracket 159 be adjusted lengthwise along the slot 32 but also laterally along the length of the elongated holes 165.

Two vertically extending members 162 of the third bracket 159 extend from the base 160 and may be mounted on the continuous slot 32 at a pre-determined distance from the clevis pin 30. The two extending members 162 may further comprise yellow plastic sleeves 142 so as to define digits 139.

The use of third bracket 159 provides a simple one piece device that may be easily installed. The position of the two vertically extending members 162 to the clevis pin 30 may be indicative of the brake stroke condition of the vehicle braking system.

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Moreover, it is also possible that one of the extending members or digits 162 may extend beyond the end of the elongated member 14 in the region remote from the attachment portion 16 by only utilizing one nut and bolt to secure the third bracket to the elongated member 14. In other words one of the digits 162 will extend beyond the attachment member in the condition, for example, when the elongated member is not long enough when attached. Moreover the two members 162 could be bent at an angle at any portion along 162 (for example at a right angle to the base 160).

In the embodiment shown in figures 8a, 8b and 8c the third bracket 159 and particularly the digits 139 are adjustable relative to the clevis pin both in a first direction and a second direction relative to the clevis pin. In other words, the first direction is in a

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direction parallel to the slot 32 of the elongated member 14 and the second direction is in a direction lateral to the slot 32 or in the direction parallel to the elongated holes 165.

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Claims

I claim:

1. A brake adjustment indicator for a braking system for a vehicle, the braking system including a pressure chamber, a pushrod extending longitudinally outwards from the pressure chamber and moveable when correctly adjusted between first and second positions, a brake arm and pivot means for pivotally mounting the pushrod to the brake arm, said brake adjustment indicator comprising:
 - (a) indicator means adapted to be mounted for longitudinal movement with the pushrod;
 - (b) support means having a first portion and a second portion, said first portion adapted to be mounted to the vehicle, said support means configured to position said second portion opposite said indicator means;
 - (c) first reference means positionable on said second portion of said support means for marking the first position and second reference means positionable on said second portion of said support means for marking the second position;
 - (d) locating means for positioning said first reference means in a preselected position relative to said second reference means, said first and second reference means mounted for simultaneous movement on said second portion of said support means; and
 - (e) locking means for fixing said first and second reference means in position on said second portion of said support means.
2. The brake adjustment indicator as claimed in claim 1 wherein said indicator means is adapted to be mounted on the pivot means.
3. The brake adjustment indicator as claimed in claim 1 wherein the pivot means includes a clevis pin and said indicator means is adapted to be mounted on the clevis pin.
4. The brake adjustment indicator as claimed in claim 1 wherein the pivot means includes a clevis pin, said second portion of said support means extends substantially parallel to the push rod and said indicator means is adapted to be mounted on the clevis pin.

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5. The brake adjustment indicator as claimed in claim 1 wherein said first position is adapted to be mounted to the pressure chamber.
6. The brake adjustment indicator as claimed in claim 1 wherein the pressure chamber
5 is mounted to the vehicle by a mounting bolt and said first portion is adapted to be mounted to the pressure chamber by a mounting bolt.
7. The brake adjustment indicator as claimed in claim 1 wherein said locating means
10 comprises a plate having first and second openings, said openings being adapted to each receive one of said reference means, said openings positioned a preselected distance apart so that when said reference means are positioned in said openings, said first reference means is in said preselected position relative to said second reference means.
8. The brake adjustment indicator as claimed in claim 7 wherein said second portion
15 includes a longitudinally extending opening, said longitudinally extending opening adapted to receive said reference means for slidable movement therein.
9. The brake adjustment indicator as claimed in claim 4 wherein
20 (a) said locating means comprises a plate having first and second openings, said openings being adapted to each receive one of said reference means, said openings positioned a preselected distance apart so that when said reference means are positioned in said openings, said first reference means is in said preselected position relative to said second reference means, and
(b) said second portion includes a longitudinally extending opening, said
25 longitudinally extending opening adapted to receive said reference means for slidable movement therein.
10. The brake adjustment as claimed in claim 1 wherein said indicator means and said
30 reference means each have an exterior surface which is of a colour that contrasts with the colour of the braking system.

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11. The brake adjustment indicator as claimed in claim 2 wherein said indicator means is positioned between the said reference means to contact said second reference means as said push rod extends past said second position when said braking system is engaged and requires adjustment.

12. The brake adjustment indicator as claimed in claim 11 wherein at least one of the end of said indicator means and the ends of said reference means are flexible.

13. A brake adjustment indicator for a braking system for a vehicle, the braking system including a pressure chamber, a rod extending longitudinally outwards from the pressure chamber and moveable when correctly adjusted between first and second positions, a brake arm and pivot means for pivotally mounting the rod to the brake arm, said brake adjustment indicator comprising:

- (a) first reference means for marking the first position and second reference means for marking the second position;
- (b) indicator means adapted to be mounted for longitudinal movement with the rod;
- (c) support means having a first position and a second position, said first position adapted to be mounted to the vehicle, said support means configured to position said second portion opposite said indicator means, said second portion of said support means extending substantially parallel to the rod and having a longitudinally extending opening adapted to receive said first and second reference means therein for longitudinal movement of said reference means;
- (d) spacer means for positioning said first reference means in a preselected position relative to said second reference means; and,
- (e) locking means for fixing said first and second reference means in position on said second portion of said support means.

14. The brake adjustment indicator as claimed in claim 13 wherein said indicator means is adapted to be mounted on the pivot means.

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15. The brake adjustment indicator as claimed in claim 14 wherein the pivot means includes a clevis pin and said indicator means is adapted to be mounted on the clevis pin.

16. The brake adjustment indicator as claimed in claim 14 wherein the pressure chamber
5 is mounted to the vehicle by at least one mounting bolt and said first portion is adapted to be mounted to the pressure chamber by at least one of said mounting bolts.

17. The brake adjustment indicator as claimed in claim 14 wherein said spacer means
10 comprises a plate having first and second openings, said reference means extending through said longitudinally extending opening of said support means and said first and second openings; said first and second openings positioned a preselected distance apart to position said first reference means in a preselected position relative to said second reference.

18. The brake adjustment indicator as claimed in claim 14 wherein said indicator means
15 and said reference means each have an exterior surface which is of a colour that contrasts with the colour of the braking system.

19. The brake adjustment indicator as claimed in claim 18 wherein at least one of the end
of said indicator means and the ends of said reference means are flexible.

20. 20. An indicator for determining brake stroke condition on a vehicle braking system
comprising:

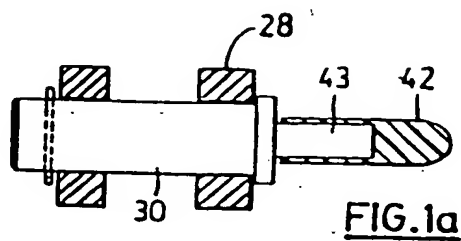
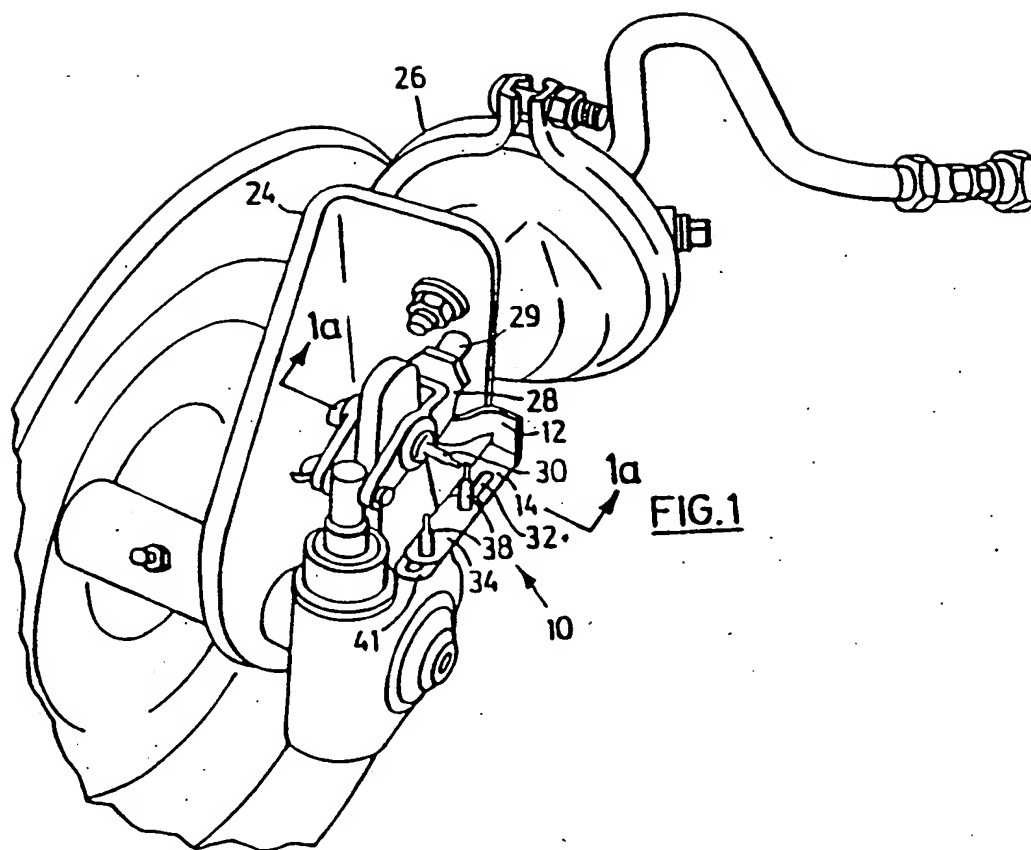
- 25 (a) a bracket having an elongated member having at one end an attachment portion located generally at a right angle to said elongated member, said bracket mounted to a chamber mounting bracket which supports a brake chamber, said brake chamber having a clevis assembly including a clevis pin that connects said clevis assembly to a brake arm;
- (b) a continuous slot extending along the length of said elongated member, said elongated member running parallel to said clevis assembly;
- 30 (c) a bracket detachably mounted to said continuous slot along said elongated member by an attachment means, further comprising a base and two extending members from said base;

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the portion of said vertical extending member being a pre-determined distance from clevis pin, thereby being indicative of the brake stroke condition on the vehicle braking system.

- 5 21. An indicator as claimed in claim 20 wherein said bracket includes a base and two extending members in a common plane with said base member.
22. An indicator as claimed in claim 21 wherein said holes are adapted to include attachment means so as to attach said base to said elongated member.
- 10 23. An indicator as claimed in claim 22 wherein said attachment means comprises of threaded fasteners.
24. An indicator as claimed in claim 23 wherein said holes are elongated so as to permit
15 said bracket be adjusted in a first and second direction.
25. An indicator as claims in claim 24 wherein said elongated member occupies a first plane that is substantially perpendicular to a second plane occupied by said attachment
20 portion such that the first plane passes through the confines of the centre of said plurality of holes.

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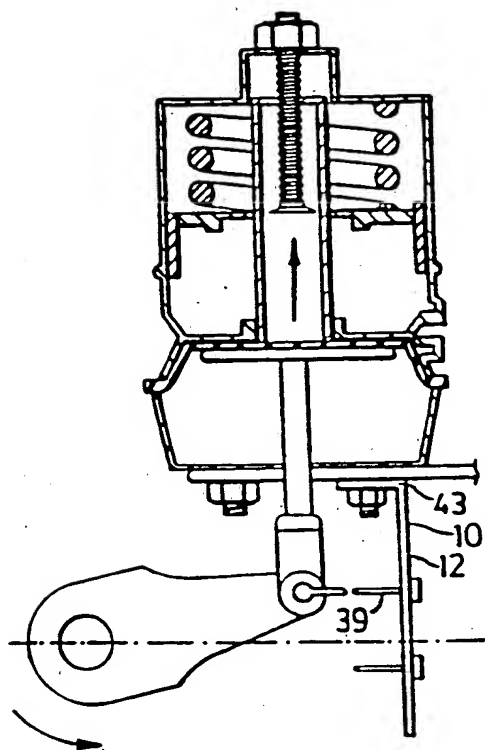


FIG. 2

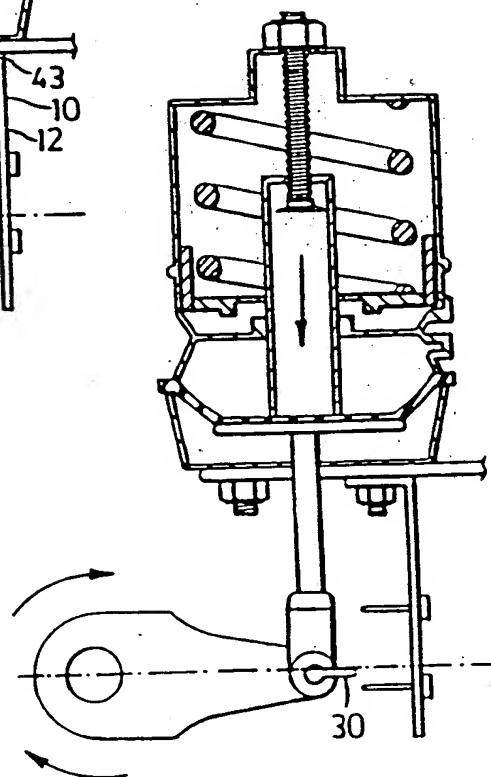


FIG. 3

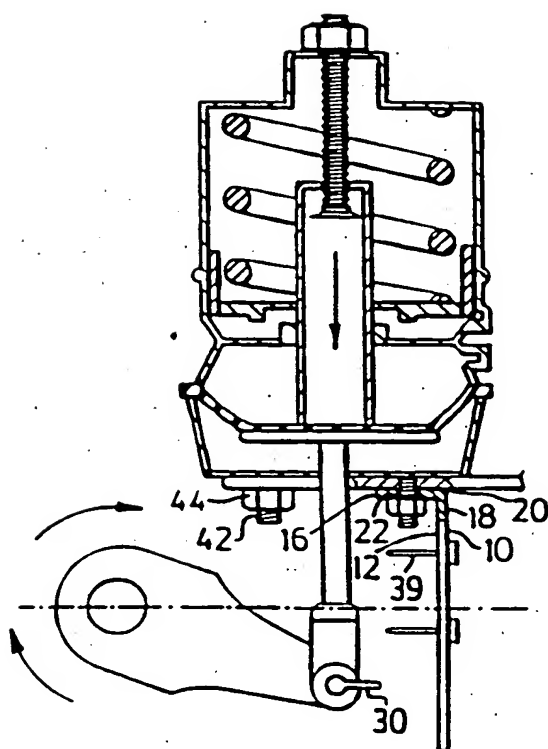


FIG. 4

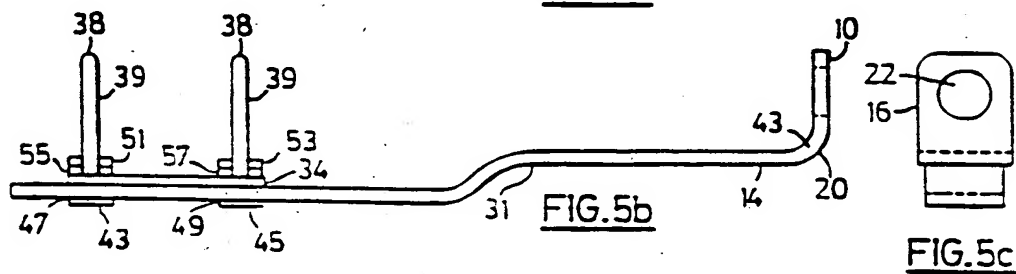
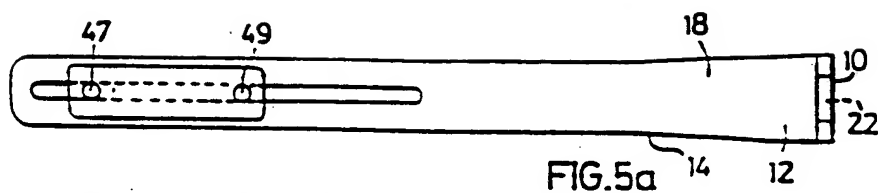
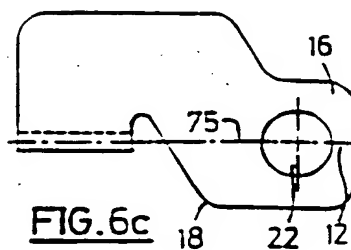
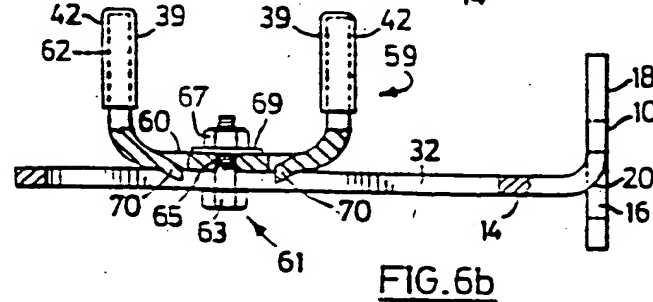
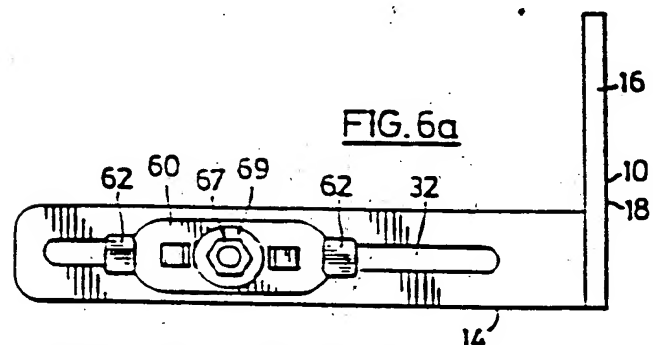


FIG. 5c



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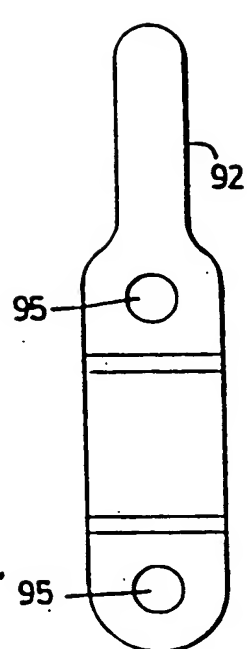


FIG. 7a

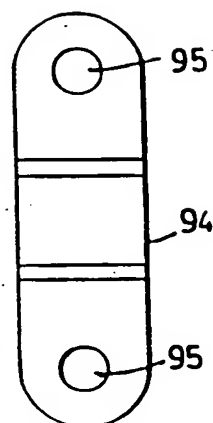


FIG. 7b

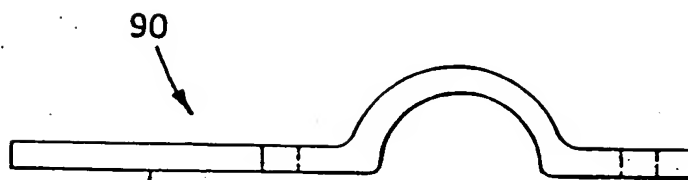


FIG. 7c



FIG. 7d

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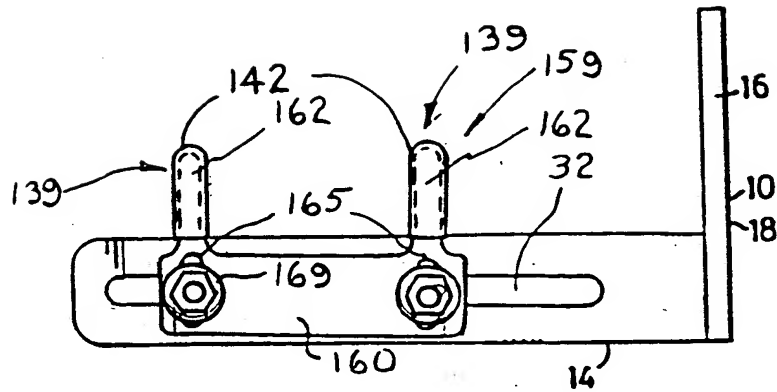


FIG. 8a

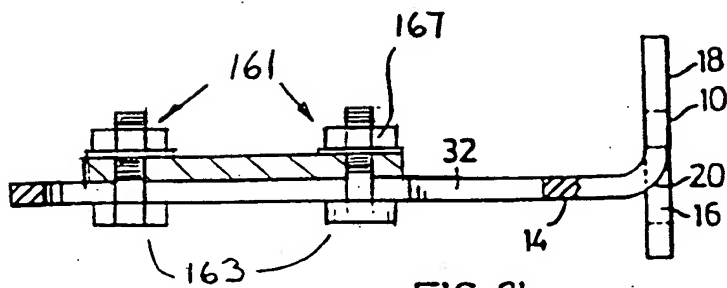


FIG. 8b

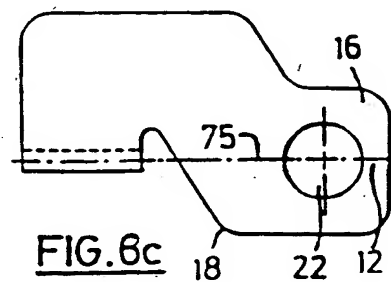


FIG. 8c

INTERNATIONAL SEARCH REPORT

Int. Appl. No.

PCT/CA 98/00124

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16D66/02 B60T17/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16D B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------|
| X | CA 2 186 271 A (MR SAFETY CHECK SYSTEMS INC) 2 November 1996 cited in the application see the whole document | 1-9, 11, 13-17, 19-25 |
| P, X | & US 5 699 880 A (HOCKLEY DES) 23 December 1997 | 1-9, 11, 13-17, 19-25 |
| A | US 4 945 818 A (WARE NATHAN C) 7 August 1990 see abstract; figures 2,3 | 1, 13, 20 |
| A | US 4 991 310 A (MELIA CLIFFORD T) 12 February 1991 see abstract; figures 1,2 | 1, 13, 20 |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

20 May 1998

Date of mailing of the international search report

05/06/1998

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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| A | <p>US 5 381 662 A (ETHEN RICHARD M ET AL) 17 January 1995 see abstract; figures 1-4B -----</p> | <p>1,13,20</p> |

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